ASTRONOMICAL PHENOMENA FOR THE WEEK 1886 *JANUARY* 3-9

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on January 3

Sun rises, 8h. 8m.; souths, 12h. 4m. 48·8s.; sets, 16h. 2m.; decl. on meridian, 22° 48′ S.: Sidereal Time at Sunset, 22h. 55m.

Moon (New on January 5) rises, 6h. 7m.; souths, 10h. 36m.; sets, 15h. 3m.; decl. on meridian, 18° 12′ S.

Planet	Rises h. m.	Souths h. m.	Sets h. m.	Decl. on meridian ° ′
Mercury	6 17	10 28	14 39	20 41 S.
Venus	10 6	15 6	20 6	12 23 S.
Mars	22 13*	4 46	11 19	5 45 N.
Jupiter	23 32*	5 31	11 30	0 59 S.
Saturn	15 14	23 24	7 34*	22 33 N.

* Indicates that the rising is that of the preceding and the setting that of the following day.

Phenomena of Jupiter's Satellites

Jan.	h. m.		Jan.	h. m.	
4	1 13	IV. ecl. reap.	6	6 58	I. occ. reap.
4	1 29	II. ecl. disap.	7	1 51	I. tr. ing.
4	6 44	II. occ. reap.	7	4 6	I. tr. egr.
5	6 29	III. ecl. disap.	8	1 26	I. occ. reap.
5	7 23	I. tr. ing.	9	1 11	III. tr. ing.
6	1 46	II. tr. egr.	9	4 0	III. tr. egr.
6	3 31	I. ecl. disap.			

The Phenomena of Jupiter's Satellites are such as are visible at Greenwich.

Saturn, January 3.—Outer major axis of outer ring 46″·6; outer minor axis of outer ring 20″·5; southern surface visible.

Jan. h.
9 ... 2 ... Mercury at greatest elongation from the Sun, 23° west.

Variable Stars

Star	R.A. h. m.	Decl. ° ′		h. m.	
U Cephei	0 52·2	81 16 N.	Jan. 3,	1 5	*m*
W Virginis	13 20·2	2 47 S.	,, 4,	9 30	*M*
δ Libræ	14 54·9	8 4 S.	,, 5,	18 13	*m*
U Coronæ	15 13·6	32 4 N.	,, 6,	3 41	*m*
R Serpentis	15 45·4	15 29 N.	,, 5,		*M*
U Ophiuchi	17 10·8	1 20 N.	,, 5,	4 45	*m*
			,, 6,	0 53	*m*
			,, 6,	21 1	*m*
δ Cephei	22 24·9	57 50 N.	,, 6,	17 0	*m*
S Aquarii	22 51·0	20 57 S.	,, 6,		*M*

M signifies maximum; *m* minimum.

Meteor Showers

Meteors have been observed during this week in former years from the following radiants:—Near β Aurigæ, R.A. 93°, Decl. 43° N.; R.A. 145°, Decl. 5° N.; R.A. 150°, Decl. 67° N.; and R.A. 181°, Decl. 35° N.

GEOGRAPHICAL NOTES

THE current number of *Petermann's Mittheilungen* contains an account of Herr Menge's second journey in the Somali Peninsula, accompanied by an excellent map showing the courses of both journeys. The traveller's meteorological observations and measurements, worked out by Dr. Schmidt of Gotha, are appended to the paper. Dr. Paulitschke's account of his journeys to Harar and amongst the Northern Gallas is concluded in this number. It contains a mass of interesting information of all descriptions with regard to this region. In an appendix a sketch is given of the scientific results of the journey, arranged under the heads—astronomical and magnetic observations, topography, anthropology and ethnography, and natural history.

THE *Bulletin* of the Paris Society of Geography just published (3e trimestre, 1885) contains the full text, with maps, of Dr. Heis's journeys amongst the Laos. M. Errington de la Croix, under the title of "Seven Months in the Tin Country," describes the method of working the tin-mines of Perak, in the Malay Peninsula. The only other paper in the number is one of great interest by M. Pinast on certain explorations of his in the State of Panama, especially in the regions around the Chiriqui lagoon, and the districts inhabited by the Guaymi Indians.

THE last Ergänzungsheft, or supplementary number of *Petermann's Mittheilungen*, is a lengthy account by Dr. Boas of his journeys during 1883 and 1884 in Baffin Land. It is divided into four main parts: an account of the journey from day to day, worked into a narrative; the history of past discoveries in the same region; geography; and, lastly, anthropo-geography. One appendix contains a long list of Eskimo place-names in Baffin Land, with their meanings; another gives a number of astronomical observations at various stations. The work is accompanied by two maps, one of Cumberland Sound and Cumberland Peninsula; the other represents the distribution of Eskimo tribes in Baffin Land.

THE current number of the *Proceedings* of the Vienna Geographical Society (Bd. xxviii. No. 11) contains a paper entitled "Shamanism in Upper Austria," by Dr. Zehden. The district specially referred to is the wide granite plateau which forms the watershed between Bohemia and Upper Austria, and the paper describes the old superstitions and practices still surviving amongst the comparatively primitive people who inhabit the district. The application of the term "Shamanism" to these in the bulk is curious, and somewhat questionable. Shamanism is the form of Buddhism ("Northern Buddhism") prevailing amongst the Mongols and Thibetans, the *Shaman*, or priest, being one who has overcome all his passions. It is said to be a word of Hindu origin. The Pope of this sect, which differs from the Buddhism of India and Ceylon more in state and power than in doctrine, is the Dalai Lama at Lhassa. It has an enormous literature, which is described as the dreariest in existence. Like every other form of religion, and perhaps more than most religions of civilised peoples, it has its superstitious practices and beliefs; but there appears no more excuse for transferring this name from Thibet and Mongolia to Austria, and applying it to superstitions there, than for calling the latter Babylonian, Chaldean, or something else that has no connection whatever with them. The number also contains further letters from Dr. Lenz, in charge of the Austrian expedition to the Congo.

A TELEGRAM was received in Berlin on the 27th inst., announcing the death of Dr. Büttner, a German explorer travelling in Bonnyland, in Africa. The deceased, like Livingstone, was formerly engaged in missionary work in South Africa.

TEMPERATURE OF THE SURFACE OF THE MOON

IN a memoir on this subject presented to the U.S. National Academy of Sciences by Prof. S. P. Langley, the author concludes by reviewing as follows our sources of information, and weighing the imperfect and contradictory results each has brought us:—

(1) *Direct Measurement of Lunar Heat as compared with Solar.*—Our direct comparison indicates that we receive nearly the whole proportion of solar energy from the full moon that we should expect to get from a diffusive disk of the same angular aperture. This heat must in reality be partly diffused and partly radiated, and we do not know (from the present observations) in what proportions these two kinds enter. So far as the observation itself is reliable, we may, however, infer that our atmosphere is permeable to most of the lunar heat of either kind, but the method is unfortunately subject to such large sources of constant error, that we cannot derive great confidence from the apparent agreement of different observations or even of different observers. It may be said, however, to create a certain presumption that the earth's atmosphere is diathermanous to heat of lower wave-length than has been heretofore supposed, *and of lower wave-length than appears to reach us from the sun.*

(2) *Comparison of Moon's Heat with that of Leslie Cube.*—If we may draw any inference from this class of observations it is that the sunlit surface of the moon is not far from the freezing temperature, but not so far below as we might expect to find that of an absolutely airless planet.

(3) *Transmission of Lunar Heat by the Earth's Atmosphere.*—Our observations indicate a not materially greater co-efficient of transmission for lunar heat than for solar; and though their

limited number and the uncertainty of the correction for change of heat with phase render more certainty as to the fact desirable, we may (accepting them as probable) reason thus.

Previous observations both at Allegheny and Mount Whitney have shown that the solar rays are transmitted with greater and greater facility (except for cold bands) as the wave-length increases up to the point (near $\lambda = 3^{\mu}$) where they suddenly disappear altogether. This shows either that (1) the solar heat, which, according to the customary assumption, exists to an unlimited wave-length before absorption, has here been cut off by a suddenly absorbent action, like that of a cold band extending indefinitely below 3^{μ}, or (2) that, either through a precedent absorption of such rays in the sun's own atmosphere or their non-existence, no solar rays below 3^{μ} present themselves to our atmosphere for admission.

The first view is that which I have treated as most in accordance with received opinion. It is not, however, the only one, since the second is not to be absolutely rejected, considering our experimental ignorance of the laws of radiation from gaseous bodies for great wave-lengths. Of these two hypotheses we see that, according to the first, our atmosphere is quite opaque to all heat below 3^{μ}, and the writer's (unpublished) experiments show that heat above this point must come almost wholly from a source much above 100° C. In this view, then (unless we agree that the radiations from the lunar soil correspond to a source much above 100° C.), we conclude that sensibly none of them pass our atmosphere, but that what we receive is diffused and reflected heat coming within the range of the known solar energy spectrum, and transmitted with nearly the same facility as solar heat, or if with a little greater, because lowered in wave-length by selective reflection at the lunar surface, not by absorption and re-radiation from the lunar soil.

In the second view, for anything we have absolutely known to the contrary, our atmosphere may be permeable to radiations of any wave-length below 3^{μ}, and we could draw no certain inference, even if the lunar radiation were more distinctly different in transmissibility than it is.

As a matter of fact, with the actually limited difference in the character of its transmissibility, a difference which, as so far determined, is of the same order as that of the error of observation, we have no ground then from this present class of observation (*i.e.* Class 3) for any absolute conclusion one way or the other. But, we repeat, it seems to be a probable inference from our whole work that the earth's atmosphere is more diathermanous to heat of extremely low refrangibility than has heretofore been supposed.

(4) *Comparative Transmission of Glass for Lunar and Solar Heat.*—The evidence here, which at first seems to so directly support the view of a sensible radiation from the surface of the moon, proves, on examination, to be subject to other interpretation, for the observed effect is almost certainly due in part to a degradation of wave-length by selective reflection from the lunar soil.

We can draw no absolute conclusion, then, from this evidence, at first in appearance so promising, though we may say that it certainly indicates an increased probability for the view that radiations from the lunar soil may be transmissible by our atmosphere.

(5) *Observations during a Lunar Eclipse.*—If our own observations in this respect are imperfect, those of Lord Rosse, before cited, are, on the other hand, clear. They appear to bear but one interpretation—that all heat from the moon disappears immediately that it passes into the earth's shadow, and there is no evidence of any being retained, for any sensible time, more than if it were reflected.

It is so difficult to conceive that while the moon has been storing heat during many days of sunshine, it can part with it instantly, so that the temperature of the whole earthward surface of the planet disappears in an inappreciable interval, that most will see in this observation an argument against the existence of any such heat sensible to us at any time whatever.

(6) *Formation of a Lunar Heat Spectrum.*—The observations made here with the lunar heat spectrum are as yet incomplete. With improving experience and apparatus, we hope to make others which shall give information of a character no other means can furnish (see note, *infra*).

Conclusion.—While we have found abundant evidence of heat from the moon, every method we have tried, or that has been tried by others, for determining the character of this heat appears to us inconclusive; and, without questioning that the moon radiates heat earthward from its soil, we have not yet found any experimental means of discriminating with such certainty between this and reflected heat that it is not open to misinterpretation. Whether we do so or not in the future will probably depend on our ability to measure by some process which will inform us directly of the wave-lengths of the heat observed.

Note added February, 1885.—Since the above paragraph was written, we have succeeded in obtaining measures with rock-salt prisms and lenses in a lunar *heat spectrum*. These difficult measures must be repeated at many lunations before complete results can be obtained; but, considering their importance to the present subject, we think it best to state now in general terms, and with the reserve due to the necessity of future experiment, that they indicate two maxima in the heat curve—one corresponding within the limits of errors of observation to the solar curve maximum, the second indefinitely lower down in the spectrum, corresponding to a greater amount of heat at a lower temperature. Exactly what temperature this latter corresponds to we have no present means of knowing. We have succeeded, however, in forming a measurable heat-spectrum from the surface of a Leslie cube containing boiling water, and the maximum ordinate in the lunar heat curve appears to be below the maximum ordinate in the hot water curve. The inference from this is, of course, that the temperature of the lunar soil is, at any rate, below that of boiling water, and in an indefinite degree.

We cannot close this note without calling attention to the remarkable fact that we here seem to have radiations from the moon of lower wave-length than from the sun, which implies an apparent contradiction to the almost universally accepted belief that the sun's emanations, like those from any heated solid body, include all low wave-lengths representing temperatures inferior to those certainly emitted.

SYMBIOSIS BETWEEN FUNGI AND THE ROOTS OF FLOWERING PLANTS

A VERY remarkable phenomenon has for some time past attracted the attention of a few physiological botanists in France and Germany, and was the subject of an interesting discussion at the annual meeting of the Association of German Naturalists and Physicians at Strassburg in September last. This is no less than the discovery of the fact, which may now be considered fairly established, that a considerable number of phanerogams, especially forest trees, do not draw their nourishment directly from the soil, but through the medium of an investing layer of fungus-mycelium, to which B. Frank gives the name of Mycorhiza.

The observations which first called the attention of botanists to this interesting subject were those of F. Kamienski, on *Monotropa hypopitys*, published in the *Mém. de la Soc. Nationale des Sci. Nat. de Cherbourg*. He came to the conclusion that this plant is not, as is usually believed, a parasite, the most careful observation failing to detect any haustoria or other parasitic union with the root of any host. On the other hand, he found the root of the *Monotropa* to be completely covered by the mycelium of a fungus, which branches abundantly, and forms a pseudo-parenchymatous envelope, often two or three times the thickness of the epidermis, and especially well developed at the apex of the root. This fungus, the species of which M. Kamienski is unable to determine, is entirely superficial, not penetrating into the living cells, though occasionally forcing its way between those of the epidermis. He contends that the *Monotropa* derives its nourishment from the soil entirely through the medium of this fungus-mycelium; the only parts of the root which are in actual contact with the soil are composed of lifeless cells with no power of deriving nutriment from them. The connection of the fungus with the roots of the *Monotropa* is not one of parasitism, but of true symbiosis, each of the two organisms deriving support and nutriment from the other.

More recently similar observations on the mode of nutrition of trees belonging to the natural order Cupuliferæ have been made by Dr. B. Frank and confirmed by M. Woronin (both recorded in the *Berichte der Deutsch. Bot. Gesellschaft*). Dr. Frank finds the roots of our native oaks, beeches, hornbeams, chestnuts, and hazels, to be covered by a dense cortex of Mycorhiza, organically associated in growth with the root, and composed entirely of fungus-hyphæ, completely enveloping the whole of the root, even the growing point. The structure of this cortex is that of a sclerotium; it is composed of a dense mass of hyphæ,